

REMARKS

Reconsideration of the present application, as amended, is respectfully requested. Claims 8-13, and 18-42 of the present application are currently pending. Claims 19, 22-23, 25-26, 28, and 32 have been amended. Claims 8-13, 18, and 39-42 have been allowed.

35 U.S.C. § 112 Rejections

The Examiner has rejected claims 22, 25, and 28 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant has amended the claims to provide sufficient antecedent basis for the limitation.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 2, 25, and 28 under 35 U.S.C. § 112.

35 U.S.C. § 102 Rejections

The Examiner has rejected claims 19, 21, 23-24, 26-27, and 31 under 35 U.S.C. § 102(b) as being anticipated by McConnell. In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the following remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

With respect independent claims 19, 23, and 26, from which claims 21, 24, 27, and 31 depend, the claims recite a method of generating a measured amount of a chemical by flowing a chemical into a valve system having a tube with a known volume, filling said tube to generate a measured amount of chemical, which is approximately equal to the known volume of the tube, and then applying **only** said measured amount of chemical to a semiconductor wafer in a cleaning or etching process.

It is asserted that McConnell et al. discloses filling a tube, and that any tube has a known volume, and thus constitutes a measured amount. McConnell et al. fails because the measured amount of chemical that is applied in McConnell's wafer process is **not equal** to the measured amount previously defined by the known volume of the tube, and thus, the two measured amounts are not equivalent. Nor is there any reasonable expectation that McConnell et al. ever intended to make the two measured amounts equivalent, since McConnell et al. uses a metering pump to generate the desired measured amount used in their wafer process. McConnell fails to disclose at least the limitation that the volume of the tube **equals** the measured amount used in a single wafer process.

Examiner has asserted that the filled tube in McConnell is eventually used and that the claim limitations fail to distinguish over a filled tube dispensing its contents in multiple applications. Applicant disagrees and asserts that the claims recited applying the "measured amount of chemicals to a semiconductor wafer in a single semiconductor wafer ... process". The claim limitation requires that at least the "measured amount" be applied to a wafer. McConnell is silent regarding whether more or less than the measured amount is applied, but it is clear that the

amount applied is not related to the volume of the tube being filled. However, to expedite prosecution of the application, independent claims 19, 23, and 26 have been amended to better define the invention. The claims as amended now read “applying **only** said measured” chemicals to the process. The volume of chemicals applied in McConnell in a single application are not limited to “**only**” the volume of the filled tube, which constitutes the measured amount. Therefore, McConnell fails to satisfy the claim limitation contained in the amended independent claims. The claims, as amended, are believed to overcome the rejection.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants’ silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 19, 21, 23-24, 26-27, and 31 under 35 U.S.C. § 102(b) as being anticipated by McConnell.

35 U.S.C. § 103 Rejections

The Examiner has rejected claim 19 under 35 U.S.C. § 103(a) as being unpatentable over Ryu. In light of the amendment, the Examiner’s rejections have become moot. Nonetheless, the following remarks regarding the Examiner’s rejections and the amended claims may be helpful to expedite prosecution.

The claims recite a method of generating a measured amount of a chemical by flowing a chemical into a valve system having a tube with a known volume, filling said tube to generate a measured amount of chemical, which is approximately equal to the known volume of the tube, and then applying only said measured amount of chemical to a semiconductor wafer in a **single** semiconductor wafer cleaning or etching process, wherein the measured amount of chemicals is applied by **pushing** the chemicals out of the tube with a flushing fluid, selected from a group consisting of a measured amount of DI water and an inert gas, wherein the applied chemical mixture is of a known measured concentration

Ryu discloses a method of mixing large quantities of chemicals for semiconductor processing. Ryu employs two concentric tanks, wherein the inner tanks has an open top and is enclosed in the larger tank. Ryu discloses filling the larger tank, and thus overfilling the inner tank, then the larger tank is drained, leaving the inner tank filled to the top, which is the measured amount of chemical. Ryu's process then drains the inner tank into an empty mixing tank, and then fills the mixing tank with DI water, until an electronic scale, col.5, ln.23, detects the desired weight of the mixture and shuts off the DI water. Then Ryu's process involves bubbling nitrogen through the mixture to provide agitation and obtain uniform mixing.

Ryu fails to disclose or suggest the claim limitation that a flushing fluid is used to **push** the measured chemical out of the tube. There is no motivation to modify Ryu to **push** the **measured chemical** out with a **flushing fluid**, when it is **applied to a wafer**. In Ryu, the measured chemical is **not pushed out onto a wafer**,

nor is a **flushing** fluid used to push out the measured chemical. Rather, in Ryu the measured chemical is drained into a tank, without a flushing fluid pushing it out. Furthermore, the apparatus in Ryu appears not to be able to be successfully modified to read on the claimed limitations.

Examiner has recognized that Ryu fails to disclose applying the measured amount to a single semiconductor wafer. Examiner then asserts that it would be obvious to apply the mixed HF solution to a single semiconductor wafer, with an expectation of successful results. Examiner recognizes that Ryu provides no suggestion to modify, but Examiner asserts that it is well known in the art to clean wafers one at a time.

Applicant disagrees that it would be obvious to modify Ryu to a single wafer process because an ordinary artisan would quickly recognize that the Ryu process would take much too long to be useable in a single wafer process. The process in Ryu requires many steps, each of which are very slow steps, relative to applicant's invention of a single fill and apply step. Ryu must fill, then slowly partially drain, so as to properly top off the inner tube, then apply measured fluid to a mixing tank, then add DI water, then mix with nitrogen gas, then apply to a wafer. The Ryu process is extremely impractical and would **not** be successful as a single wafer process. Therefore, the ordinary artisan would have no motivation to modify Ryu to create an impractical single wafer process.

Ryu actually appears to teach away from using the process as a single wafer process by providing an example of mixing 100 cc of HF with 9.9 liters of DI water,

col.5, ln.25-30. Mixing 10 liters of diluted HF is a volume useful for mixing a batch of chemicals for many wafers, and not for a single wafer.

In conclusion, Applicant asserts that Ryu fails to disclose or suggest all the limitations of the claim. Applicant assert that it would not be obvious, nor does the prior art contain any motivation to modify Ryu to a single wafer process, nor would such a modification be successful. The rejection appears to be the result of hindsight reasoning. The claim, as amended, is believed to overcome the rejection.

Applicant, accordingly, respectfully requests withdrawal of the rejection of claim19 under 35 U.S.C. § 103(a) as being unpatentable over Ryu.

The Examiner has rejected claims 19-20, 23-24, and 26-27 under 35 U.S.C. § 103(a) as being unpatentable over Nakata in view of McConnell. In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the following remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

With respect independent claims 19, 23, and 26, from which claims 20, 24, and 27 depend, the claims recite and the invention relates to a method of generating a measured amount of a chemical by flowing a chemical into a valve system having a tube with a known volume, filling said tube to generate a measured amount of chemical, which is approximately equal to the known volume of the tube, and then applying only said measured amount of chemical to either a semiconductor wafer in a cleaning or etching process, or into a mixing chamber to be mixed with a second chemical, also of a known volume. The measured amount of chemicals is applied by

pushing the chemicals out of the tube with a flushing fluid, selected from a group consisting of a measured amount of DI water and an inert gas; and wherein the applied chemical mixture is of a known measured concentration.

In a semiconductor wafer processing operation it is important to generate a consistent concentration of chemicals when either, mixed with a second chemical, diluted, or applied directly on the wafer. The concentration of chemicals controls the rate of reaction occurring on the wafer surface. The total amount of chemical applied affects the expose time of the wafer to these chemicals, and thus controls the amount or degree of reaction. Therefore, the invention relates to consistent control of both the volume and concentration of chemicals dispensed onto each wafer processed. The use of an inert gas to flush the chemical does not dilute the chemical and thus preserves the known measured concentration of the chemical mixture. The use of a known measured amount of DI water to flush the chemical, dilutes the chemical, but is a known and measured quantity, thus also resulting in a known measured concentration of the chemical mixture.

In contrast, Nakata discloses a valve system used in taking samples to carry out gas analysis, such as with vapor phase chromatography. See col.1, lines 56-61. The primary concerns in Nakata are to deliver a predetermined and reproducible volume of sample gas into the carrier stream, but the carrier stream is **not** of a known or measured quantity. Nakata is silent regarding the volume of the carrier stream, as is the practice in the art of chromatography, since the volume of carrier gas is generally not of concern.

In vapor phase chromatography, as in chromatography in general, the objective is to inject a known volume of sample gas into a continuous carrier gas

stream, which then passes through a packed column, which causes the constituents of the sample gas to separate out from each other. The lighter components pass through faster than the heavier components. Detectors measure the amount of material components that pass through, as well as, when they pass through, which is then used to determine the components, and their volumes, by comparing the sample's output to a known calibration sample's output. Even though the carrier gas dilutes the sample gas, the concentration of sample gas in the carrier gas becomes a function of time, location, and the constituents of the sample itself. Some constituents of some samples may take longer to get through and thus require more carrier gas to push it through, thus changing the volume of carrier gas used. Furthermore, the results are not strongly affected by the concentration of sample gas to carrier gas. Since the chromatography process contains no reactions, cleanings, or etchings, the concentration of the sample gas in the carrier gas is not important, and therefore is not known nor measured.

Nakata does not disclose, nor suggest, forming a chemical mixture of a known and measured concentration. Nakata does not disclose, nor suggest, any controls or limitations on the total volume of carrier gas to be mixed with the known volume of sample gas. Consequently, mixing an accurate measure of sample gas into an uncontrolled, and unknown volume of carrier gas, results in an unknown and unmeasured concentration. Therefore, Nakata fails to disclose, nor suggest, all the limitations of the claims.

Applicant asserts that it would not be obvious to combine McConnell with Nakata. The Examiner's rejection requires that it would be obvious to modify a vapor phase chromatography apparatus and process to an apparatus and process

that cleans and etches single semiconductor wafers. Examiner fails to provide any direction as to how such a transition would occur, nor are any motivations provided to justify such a dramatic modification of Nakata. Furthermore, Nakata teaches away from McConnell and from the claims. Nakata strongly seeks a transient concentration of sample in both time and location, whereas in McConnell and in Applicant's invention, variations in chemical concentrations in both time and a location would result in over and/or under etches, even on the same wafer, and from wafer to wafer, which would be considered unacceptable in the semiconductor industry. Single semiconductor wafer processes require uniformity, which seeks consistent and uniform concentrations, both in location and time. It appears that the rejection uses hindsight reasoning to attempt to reconstruct the claims from an assortment of components stemming from various references, which are neither compatible nor combinable.

Presumably with regard to independent claim 26, the Examiner asserts that it would be obvious to modify Nakata to inject a measured amount of HF into a stream of water, to allegedly produce an **accurate concentration** for semiconductor processing. This assertion is erroneous because the "**water stream**" volume is not controlled or measured, and thus its volume is not accurate, thus it would not likely be functionally possible to consistently produce an accurately desired concentration from the mixture of one accurate component with one inaccurate component. The claim requires that a measured amount of the first chemical is mixed into a chamber and the chamber is filled to a predetermined level with a second chemical. Thus

both the first and second chemicals are consistently known, measured, and controlled, thus producing a **known measured concentration**. These elements are not disclosed nor suggested by neither Nakata nor by McConnell.

With regard to independent claims 19 and 23, Applicant's assert that not only do the references teach away from their combination, as discussed above, but also, as discussed above, the Examiner's rejection fails to contain all the elements of the claims. The claims require that the chemical mixture is a known and measured concentration. In the claims, the use of an inert gas to push out a liquid chemical, would not dilute the liquid chemical because they do not mix, and thus, its concentration would not change. Therefore, if the concentration of the chemical liquid was known and measured before the use of an inert gas, then its concentration would be known and measured afterwards also.

In contrast, Nakata discloses mixing the sample gas into the carrier gas stream, which serves to dilute the sample gas since they are both gases and mix. Since the carrier gas volume is unknown and not measured, the concentration is not known nor measured. Nakata fails to teach all the limitations of the claimed invention.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 19-20, 23-24, and 26-27 under 35 U.S.C. § 103(a) as being unpatentable over Nakata in view of McConnell.

The Examiner has rejected claims 20, and 29-30 under 35 U.S.C. § 103(a) as being unpatentable over McConnell. In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the above remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 20 and 29-30 under 35 U.S.C. § 103(a) as being unpatentable over McConnell.

The Examiner has rejected claims 22, 25, and 28 under 35 U.S.C. § 103(a) as being unpatentable over Nakata in view of McConnell as applied to claims 19, 23, and 26 above, and further in view of Shackelford. In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the following remarks, in

addition to the above remarks, regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

In view of the above remarks, a specific discussion of these dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

In the above remarks, Nakata discloses a vapor phase chromatography apparatus, McConnell discloses a semiconductor process, and Shackelford discloses a high pressure injection valve used in a liquid chromatographic system.

Shackelford is introduced to supply the limitation of interchanging the tube to change the volume of chemical used in the above dependent claims. Both Nakata and Shackelford do not disclose nor suggest any control over the quantity of carrier gas or liquid used to mix with the sample. Consequently, both Nakata and Shackelford fail to disclose or suggest the application of a chemical mixture of a known and measured concentration. Shackelford fails to remedy the deficiencies of Nakata and McConnell, thus the independent claims are asserted to also overcome the inclusion of Shackelford. The cited prior art either alone or in combination fail to disclose or suggest the claimed invention.

Examiner's rejection requires that it would be obvious to modify a vapor phase chromatography apparatus and process to an apparatus and process that cleans and etches single semiconductor wafers. Shackelford fails to remedy the deficiencies in Nakata and McConnell. Shackelford fails to disclose an accurately

measured volume of carrier liquid, and thus fails to disclose or suggest an accurate concentration. It appears that the rejection uses hindsight reasoning to attempt to reconstruct the claims from an assortment of components stemming from various references, which are neither compatible nor combinable.

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 22, 25, and 28 under 35 U.S.C. § 103(a) as being unpatentable over Nakata in view of McConnell as applied to claims 19, 23, and 26 above, and further in view of Shackelford.

35 U.S.C. § 102 Rejections

The Examiner has rejected claims 32-38 under 35 U.S.C. § 102(b) as being unpatentable by US Patent 3291347 by Blades. In light of the amendment, the Examiner's rejections have become moot. Nonetheless, the following remarks regarding the Examiner's rejections and the amended claims may be helpful to expedite prosecution.

With regard to independent claim 32, the claim contains the limitation that "at least one of said flushing fluids have an approximately know volume." Blade fails to either disclose or suggest this limitation. Blade, fig.6, col.4, ln.15-42, discloses

a method of mixing, wherein the first fluid is flushed by the second fluid, and the second fluid is flushed by a first fluid, but Blade is silent regarding the volume of flushing fluids used. Furthermore, Blade makes no provisions to control or monitor the volume of flushing fluid used, thus making the volume "unknown".

In view of the above remarks, a specific discussion of the dependent claims is considered to be unnecessary. Therefore, Applicants' silence regarding any dependent claim is not to be interpreted as agreement with, or acquiescence to, the rejection of such claim or as waiving any argument regarding that claim.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 32-38 under 35 U.S.C. § 102(b) as being unpatentable by US Patent 3291347 by Blades.

Allowable Subject Matter

Applicant has noted, with appreciation, that the Examiner has allowed claims 8-13, 18, and 39-42.

Applicant respectfully submits that the present application is in condition for allowance. If the Examiner believes a telephone conference would expedite or assist in the allowance of the present application, the Examiner is invited to call Michael A. Bernadicou at (408) 720-8300.

Pursuant to 37 C.F.R. 1.136(a)(3), applicant(s) hereby request and authorize the U.S. Patent and Trademark Office to (1) treat any concurrent or future reply that requires a petition for extension of time as incorporating a petition for extension of time for the appropriate length of time and (2) charge all required fees, including extension of time fees and fees under 37 C.F.R. 1.16 and 1.17, to Deposit Account No. 02-2666.

Respectfully submitted,

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